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Identification of
DESTRUCTIVE ALASKA FOREST INSECTS

by J. S. HARD

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Juneau, Alaska
U.S. DEPARTMENT OF AGRICULTURE
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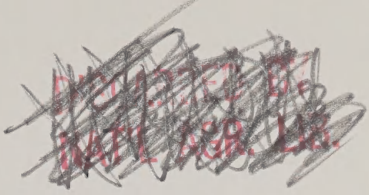

IDENTIFICATION OF DESTRUCTIVE ALASKA FOREST INSECTS

by

J. S. Hard, Associate Entomologist

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INTRODUCTION

Insects are an integral part of the forest, but only a relatively few kinds are capable of severely damaging Alaska's forests. Noticeable damage is usually accompanied by a great increase in an insect population. The outbreak or epidemic may last for one or more years and move from one forest area to another causing damage to trees on millions of acres before it subsides. The population collapse is usually quicker than its eruption. The biotic and physical factors responsible for population increase and subsidence are not well known for Alaska's destructive forest insects.

Forest insect presence and population increases are frequently first detected by the characteristic damage symptoms on host trees. This guide uses these characteristic damage symptoms to identify the causal insects. The guide does not contain information for controlling forest insect pests.

Positive identification may not always be made in the field with this guide. In addition, there is the possibility that an unlisted insect may be responsible for the damage. (Some damage symptoms, although at times characteristic of insect work, may be caused by disease or by soil and weather phenomena.) When significant damage to forest trees cannot be positively identified, samples of the damage and the causal insect should be collected. Both the damaged material and the insect, plus fresh foliage from the host tree if a defoliating insect is involved, should be placed in a plastic bag and promptly sent in a non-crushable container to:

Insect and Disease Control Section
U. S. Forest Service
P. O. Box 1628
Juneau, Alaska 99801

Entomologists at Juneau will identify the insect and return the identification. They will also provide control information on request.

HOST DAMAGE KEY

To use the key start with the first numbered pair. Go to the next number referred to and continue until one insect species or group of insects has been reached. Then check table 1, which follows immediately after the key. Use the appropriate illustrations and text to support the identification.

1. Foliage eaten 2

1. Boring in bark and stem 8

2. Evergreens damaged 3

2. Broad-leaved species damaged 6

3. Current year's foliage affected; needles clipped off and tied together with webbing to form a tubular larval shelter 4

3. All foliage affected; no tying together of needles, but hanging silk webs sometimes present 5

4. Damage to western hemlock in southeast Alaska .....
black-headed budworm, (p. 5)

4. Damage to spruce throughout Alaska.....
black-headed budworm, (p. 5)
or spruce budworm, (p. 8)

5. No webbing present; old foliage damaged most heavily; needle stubs or midribs remaining; on western hemlock only .....
hemlock sawfly, (p. 6)

5. Needles and, sometimes, small twigs clipped off, or needles eaten on one side or with bites removed; hanging silk webs present on host evergreens and hardwood understory .....
western hemlock looper, (p. 7)

6. Poplar and willow leaves skeletonized ..... leaf beetles, (p.10)

6. Leaves curled 7

213413

7. Birch, willow, and alder leaves folded, curled, or spun together to form a larval shelter ..... spear-marked black moth, (p. 9)

7. Aspen leaves rolled into tubular larval shelters .....
large aspen tortrix, (p.11)

8. Boring only in bark 9

8. Boring in bark and wood 10

9. Broad, winding larval mines in western hemlock bark, packed tightly with brown frass in concentric-arc patterns; often with 3/16- to 1/4-inch wide oval emergence holes in bark .....
flatheaded fir borer, (p.15)

9. Parallel-sided egg galleries in bark, sometimes with pitch tubes on bark at entrance holes; larval mines starting at right angles to egg galleries and packed with brown frass; often with many 1/8-inch-wide, or less, round emergence holes in bark .....
bark beetles, (p.12)

10. Tiny round holes, 1/16 inch or less wide, in bark and wood associated with small piles of fine, light-colored frass on bark ..... ambrosia beetles, 1/ (p.17)

10. Large elliptical holes, 3/16 inch or more wide, in wood associated with coarse, splintery light-colored frass; or 1/4 inch wide, or larger round emergence holes .....
roundheaded borers, 1/ (p.16)

1/ These secondary insects attack trees that are dead or dying from other causes. Their work causes considerable damage to logs.

Table 1.--Important forest insects and their hosts in Alaska

Insect species	Host species										
	Western hemlock	Sitka spruce	Western redcedar and Alaska yellow-cedar	Black cottonwood	White spruce	Black spruce	Paper birch	Balsam poplar	Aspen	Willows	Alders
Defoliators:											
Black-headed budworm, *Acleris variana*	X	X			X	X					
Hemlock sawfly, *Neodiprion tsugae*	X										
Western hemlock looper, *Lambdina fiscellaria lugubrosa*	X	X	X								X
Spruce budworm, *Choristoneura fumiferana*		X			X	X					
Spear-marked black moth, *Eulype hastata*							X			X	X
Large aspen tortrix, *Choristoneura conflictana*									X		
Leaf beetles, *Chrysomela* spp.				X				X	X	X	
Bark Beetles:											
Dendroctonus obesus 1/		X			X						
Ips concinnus		X									
Ips interruptus		X			X						
Ips perturbatus 2/					X						
Hemlock hylesinus, *Pseudohylesinus tsugae*	X										
Cedar bark beetles, *Phloeosinus* spp.			X								
Borers:											
Flatheaded fir borer, *Melanophila drummondi*	X	X			X						
Roundheaded borers	X	X	X	X	X	X	X	X	X	X	X
Ambrosia beetles	X	X	X	X	X	X	X	X	X	X	X

1/ The latest revision of the *Dendroctonus* genus combines *borealis*, common in interior Alaska, with *obesus*.

2/ The latest revision of the *Ips* genus deletes the species *interpunctus*, common in interior Alaska, and combines it with *perturbatus*.

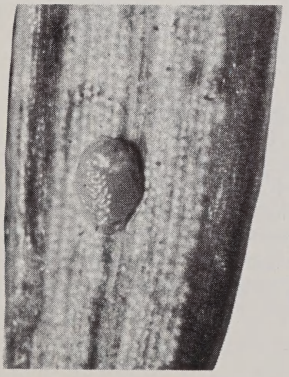
Black-headed Budworm, *Acleris variana*

Life history and description of damage.--The black-headed budworm overwinters in the egg stage. Eggs hatch in June and the larvae mine into the host buds where they remain until the buds burst. As the new shoots begin to elongate, the green-bodied, black-headed larvae feed on the new needles. Each larva (fig. 1A) ties both live and cut needles together with silk to form a shelter in which it pupates in late summer; the moths (fig. 1B) emerge between late August and early October. Shortly after emergence, the females lay yellow, flattened eggs singly on the undersurface of the host needles (fig. 1C) and occasionally on the upper surface of the needles.

Importance.--This species is the most destructive insect to the coastal forests. Epidemics occur sporadically and, if severe or prolonged, result in top-killing and tree mortality. This species is not economically important in the Interior forests.

A

B



C

Figure 1.--The black-headed budworm, *Acleris variana*: A, Mature larva, about one-half inch long; B, Moth, about three-eighths inch long; C, Egg on undersurface of western hemlock needle, greatly enlarged.

Hemlock Sawfly,
Neodiprion tsugae

Life history and description of damage. -- Hemlock sawflies normally overwinter as mature larvae in cocoons. The eggs hatch in June, and the larvae (fig. 2A) feed in groups on the old foliage. Remaining needle stubs and midribs characterize damage by this species. Larvae spin capsule-shaped brown cocoons (fig. 2B) on the host foliage, understory vegetation, and litter in August and September. Adults (fig. 2C) emerge in September and October. Shortly after emergence, the females deposit eggs singly in pockets cut into the edges of hemlock needles (fig. 2D).

Importance. --The hemlock sawfly is probably second in importance as a pest in the coastal forests. Severe defoliation has caused tree mortality. Recurrent epidemics often coincide with black-headed budworm epidemics.

A

B

C

D

Figure 2. -- The hemlock sawfly, *Neodiprion tsugae*: A, Mature larva, about three-quarters inch long; B, Cocoon, one-fourth to one-third inch long, showing opened end through which adult emerged; C, Adults, approximately five-sixteenths inch long (female upper, male lower); D, Light-colored pockets in edges of hemlock needles contain individual sawfly eggs.

Western Hemlock Looper,
Lambdina fiscellaria lugubrosa

Life history and description of damage.--The western hemlock looper overwinters in the egg stage. Larvae hatch from eggs in late spring or early summer and begin to feed on young needles. As they grow they also feed on old needles. Defoliation is not readily apparent until late summer when the clipped foliage turns brown. Thus, at the beginning of an outbreak, noticeable defoliation first appears during the last two or three weeks of larval feeding in late summer. The larvae, commonly called measuring worms or loopers, have three pairs of legs near the head and two pairs of "false" legs at the anal end. When mature, the larvae (fig. 3A) are brownish grey and have two pairs of dark spots on each body segment behind the segments that bear the front legs. When the larvae have completed development they drop to the ground on silk threads and become pupae (fig. 3B) in the litter, bark crevices, and other protected places. The moths (fig. 3C) emerge in the fall and lay their eggs in the understory shrubbery and on moss, twigs, branches, and tree trunks in the overstory.

Importance.--The western hemlock looper is one of the most destructive defoliators occurring in British Columbia and the Pacific Northwest. One year's defoliation can cause western hemlock mortality. This insect was first reported in southeast Alaska in outbreak proportions in 1965.

Figure 3.--The western hemlock looper, *Lambdina fiscellaria lugubrosa*: A, Mature larva, about one and one-fourth inch long; note characteristic feeding pattern on foliage; B, Mottled pupa, about five-eighths inch long; C, Moth, wingspread about one and three-eighths inches.

C

Spruce Budworm,
Choristoneura fumiferana

Life history and description of damage. -- Spruce budworms overwinter as young larvae in silken shelters beneath bark scales and old male flower bracts. They leave these shelters in May or June to enter and feed upon buds and old needles. After the buds burst, new foliage is attacked. Each larva (fig. 4A) ties needles together with webbing to form a shelter. Many needles are clipped off and used in the construction of these larval shelters. Damage is similar to that of the black-headed budworm. The larvae become pupae (fig. 4B) in the shelters in midsummer. The moths (fig. 4C) soon emerge and eggs are laid in masses on the host needles (fig. 4D). Larvae hatch in late summer but do not feed. They spin shelters for overwintering.

Importance.--The spruce budworm is very destructive in spruce-fir forests of the contiguous United States. Although uncommon in Alaska, it has been collected from Sitka spruce on the mainland near Haines and on the Cleveland Peninsula. It has also been collected on Revillagigedo, Prince of Wales, and Admiralty Islands. This insect is potentially dangerous to all spruce forests in Alaska.

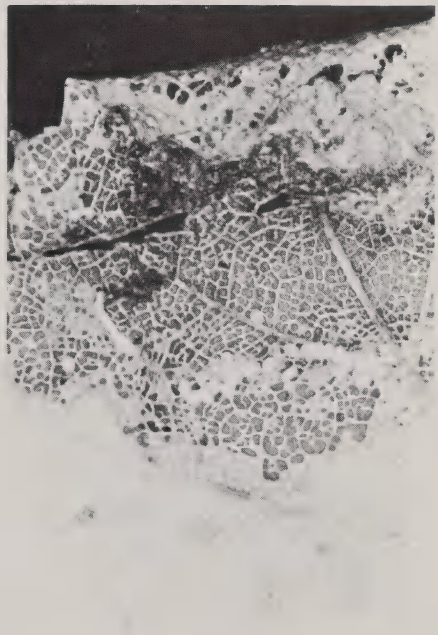
Figure 4.--The spruce budworm, *Choristoneura fumiferana* : A, top view of mature larva about one inch long; B, Pupa, about one-half inch long; C, Moth, about one-half inch long; and D, Egg mass on host needle.

Spear-marked Black Moth,
Eulype hastata

Life history and description of damage. -- This species overwinters on the ground as pupae. The moths, which are black with white markings (fig. 5A), begin to emerge in May, and lay eggs on paper birch, alder, and willow throughout June. Although the eggs are laid singly, there may be as many as 50 on a single leaf (fig. 5B). Larvae tie together the edges of one to several leaves with webbing to form tentlike shelters. As the larvae feed upon the surfaces of the leaves, the leaves become skeletonized. The larvae drop to the ground and pupate in the litter in July and August.

A

Importance. -- Defoliation by this insect is common in interior Alaska. An outbreak in 1957 included nearly 6,000,000 acres in the Fairbanks area. Approximately 333,000 acres were considered heavily infested. Repeated defoliation results in tree mortality.



B

Figure 5. -- The spear-marked black moth, *Eulype hastata* : A, Moths, showing variation in wing pattern, wingspread about one inch; B, Eggs and feeding damage on host leaf, greatly enlarged.

B

C

Figure 6.--Leaf beetles, *Chrysomela* spp.: A, Beetles, about one-quarter inch long; B, Larvae, about one-eighth inch long; C, Feeding damage on host leaves.

Leaf Beetles, *Chrysomela* spp.

Life history and description of damage.-- The yellow-and-black beetles (fig. 6A) emerge in the spring and feed on young shoots of poplar, aspen, and willow. Yellow to reddish groups of eggs are laid on the underside of host leaves. Young larvae are black (fig. 6B), but later become a dirty-yellow color. They feed on the leaf undersurface and skeletonize the leaf (fig. 6C). There may be more than one generation per year.

Importance.--Although common, this group of insects causes little economic damage to forest trees. They are more important as pests of ornamental trees.

A

Figure 7.--The large aspen tortrix, *Choristoneura conflictana*: A, Egg mass on aspen leaf; B, Mature larvae, about three-fourths inch long, on aspen leaf; C, Moth, about one inch wing spread. (Photos B and C courtesy of Canadian Department of Forestry and Rural Development, Winnipeg, Manitoba.)

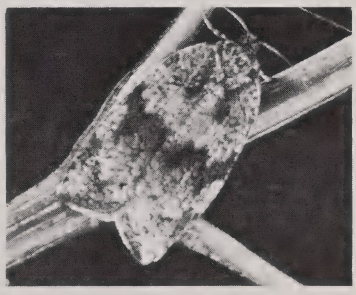
Large Aspen Tortrix, *Choristoneura conflictana*

Life history and description of damage. -- The moths lay pale green clusters of eggs primarily on the upper surface of aspen leaves (fig. 7A). In heavily defoliated areas some eggs are laid on the lower surface of the leaves. Larvae hatch from the eggs in mid-July and feed gregariously on the surface tissue of leaves that have been tied together with webbing. This initial feeding causes leaf skeletonization. In August the larvae move to the lower portions of aspen tree trunks to spin silken shelters in the bark fissures, and overwinter there. The larvae ascend the host trees in the spring and mine the buds. As the leaves emerge, the larvae roll and tie them, and feed within the enclosures. This is when most damage occurs and is most conspicuous. The mature larvae, which are dark green with black heads and posteriors (fig. 7B), become pupae within the rolled leaf enclosures. The moths (fig. 6C) emerge in late June.

Importance.--This species causes widespread defoliation of aspen in interior Alaska. Repeated defoliation may result in tree mortality.

B

C



Bark Beetles

Life history. -- The life cycles of all Alaska bark beetles are quite similar. Most species produce a single generation per year. Overwintering occurs in all stages except the egg. In spring and summer, the adults burrow into the host bark to lay eggs. A long egg gallery is made near or at the bark-wood interface, and eggs are laid singly or in groups in niches on either side. The gallery length, orientation in relation to the grain of the wood, and egg deposition pattern are usually characteristic for the species. The legless, grub-like larvae burrow at right angles to the egg galleries. Unlike the egg galleries, which have parallel sides, the larval galleries increase in width with increased larval size. When mature, each larva forms an oval cell at the end of its gallery and pupates there. New adults chew small, round emergence holes from the pupal cells to the bark exterior.

Symptoms of attack. -- The first symptoms of bark beetle infestation are small, round entrance holes in the bark sometimes associated with extruded resin pitch tubes, and frass at the tree base. As the broods develop and reach maturity many small, round emergence holes are cut in the bark. Foliage discoloration appears first at the top of the crown; soon the entire crown may fade, yellow, or redden, depending upon the host species, and the needles drop off. Riddling of the bark by woodpeckers is frequently symptomatic of beetle attack.

Importance. -- Few Alaska species are primary tree killers. However, overmature trees or trees that have been weakened by defoliation, fire, drought, or other causes are susceptible to attack. In some cases, trees near logging or blowdown areas succumb to attack by beetles that have bred in the slash and fallen trees.

Identification. -- Most bark beetles are less than one-eighth of an inch long, and their species is thus difficult to identify without the aid of a hand lens or microscope. Some, however, have distinctive gallery patterns which make identification possible. Two Alaska species with distinctive gallery patterns are *Dendroctonus obesus* (fig. 8A) and *Ips concinnus* (fig. 8B).

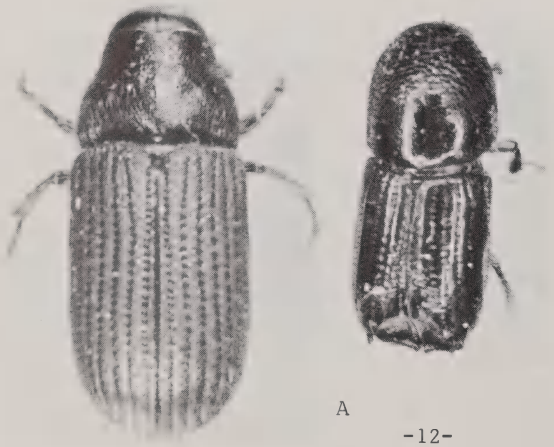


Figure 8. -- Bark beetles: A, *Dendroctonus obesus*, about one-quarter inch long; B, *Ips concinnus*, about one-eighth inch long; note spiked armature at rear end of wing covers.

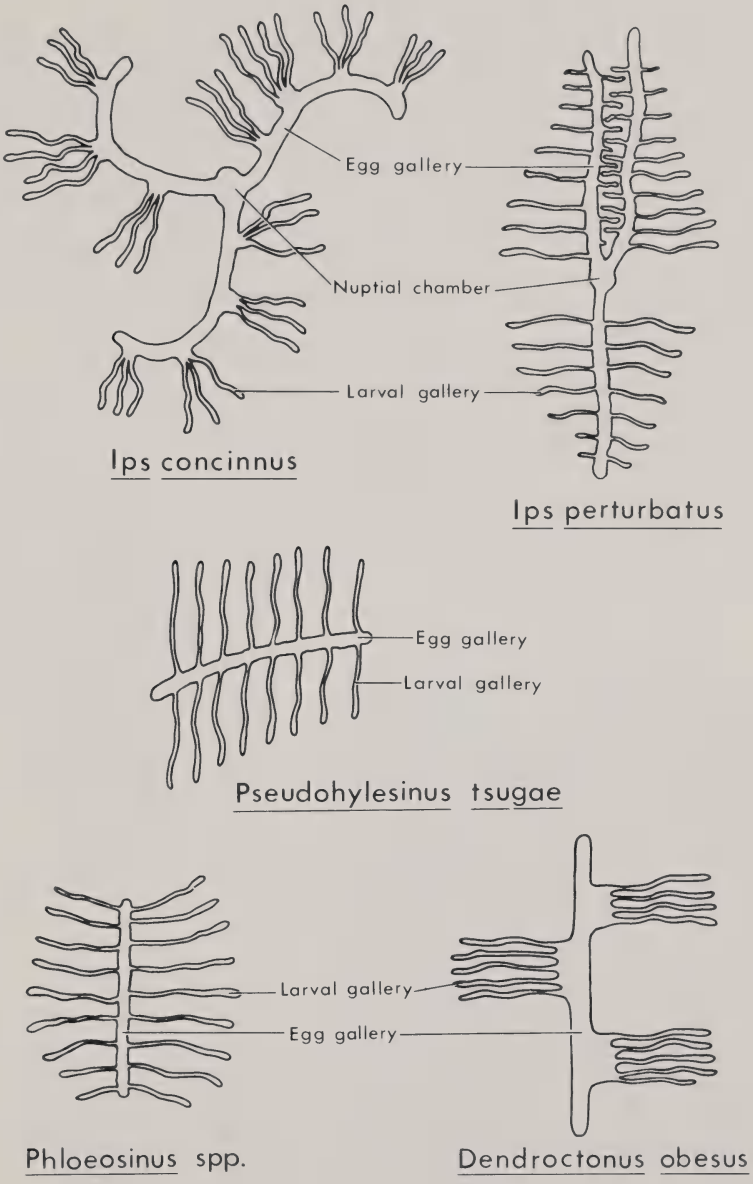


Figure 9.--Bark beetle gallery patterns, diagrammatic.

D. obesus adult beetles make a short, longitudinal tunnel and deposit groups of eggs alternately on each side. At first, each group of larvae feeds en masse, thus forming a broad gallery (fig. 9). Later the larvae feed individually, each forming a separate gallery that terminates in a pupal cell.

Ips concinnus adult beetles bore a central nuptial chamber with several curved egg galleries radiating from it. The eggs are deposited in groups of three or four at the side of the gallery. Subsequent feeding by larvae produces groups of three or four larval galleries (fig. 9).

The remaining *Ips* species form a central nuptial chamber also, but the radiating egg galleries are straighter and the eggs are deposited singly. The egg galleries tend to run with the grain and, in some cases, parallel to one another (fig. 9).

The hemlock hylesinus, *Pseudohylesinus tsugae*, makes short egg galleries at right angles to the grain. Eggs are deposited uniformly on each side of the gallery. Larvae burrow with the grain, causing a uniform gallery pattern (fig. 9).

Phloeosinus gallery patterns are similar in appearance to the patterns made by the hemlock hylesinus except that *Phloeosinus* egg galleries run with the grain and the larval galleries cut across it (fig. 9).

Flatheaded Fir Borer,
Melanophila drummondi

Life history and description of damage.--This species overwinters in the larval stage within the host bark. Pupation and adult emergence occur in the spring and summer. Emergence holes are slightly flattened on one side. The beetles (fig. 10A) deposit eggs in bark niches and crevices and larvae bore into the bark. Each larva constructs a flattened winding burrow in the cambial region. Burrows increase in width as the larvae grow larger, and are packed tightly with brown frass in concentric-arc patterns (fig. 10B). The larvae are white, with broadly flattened anteriors, and usually assume a U-shape.

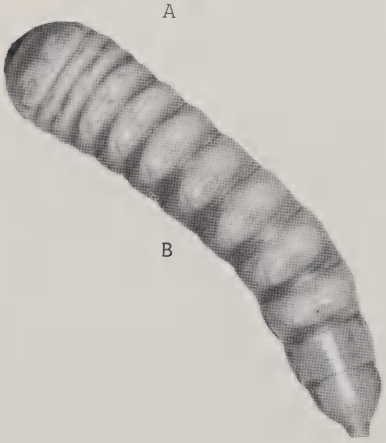
Importance. --Although it usually breeds in weakened or dying trees, this species is capable of killing healthy western hemlock trees.

A

B

Figure 10.-- The flat-headed fir borer, *Melanophila drummondi*: A, Beetle about three-eighths inch long; B, Exposed larvae and typical frass pattern.

A



B

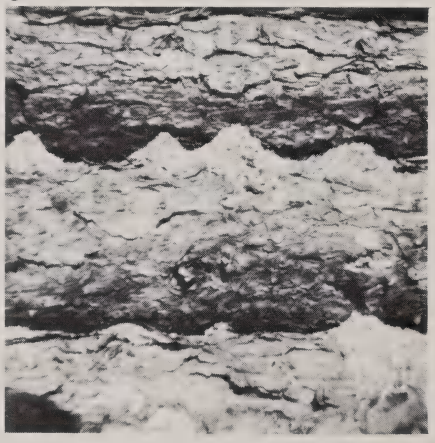
Figure 11.--Round-headed borers: A, Typical beetle, about one inch long; B, Typical larva; C, Typical coarse, splintery frass on logs. (Photo 11C courtesy of North Central Forest Experiment Station.)

Round-headed Borers

Life history and description of damage.--There is much variation in the life histories of the roundheaded borers, sometimes known as long-horn or sawyer beetles. Some have a single generation per year; others require more than one year to complete development. The beetles (fig. 11A) cut round emergence holes and lay eggs in niches on the host bark. The larvae (fig. 11B) which burrow to the cambial region feed on bark and the wood surface during the first season, but bore into the wood before winter. They enter the wood at an angle, and form oblong entrance holes. Larvae continue to feed in the wood until pupation. Coarse, splintery, light-colored larval frass characteristic of this group is usually present on infested material (fig. 11C).

Importance.--These beetles attack only dead or dying trees and material such as logs and slash. They can cause sawlogs to degrade because of the large larval burrows in the wood.

C



Ambrosia Beetles

Life history and description of damage. --Ambrosia beetles are related to the bark beetles, but are entirely different in habit. Ambrosia beetles mine into the host wood and excavate niches for rearing young (fig. 12A). Their mining results in tiny heaps of light-colored frass on the bark of the host (fig. 12B). The beetles inoculate the galleries with a fungus that grows on the wood, and which the beetles and larvae then feed on. When the young have completed development they emerge through the original entrance hole.

Importance. -- Ambrosia beetles are not tree killers, and their mines are too small to cause serious damage to sawlogs. However, the fungus they introduce into the galleries causes blue-staining of the wood and consequent degrading. They attack both hardwoods and softwoods.

A

B

Figure 12.--Ambrosia beetles: A, Typical burrows and larval niches in wood with associated wood discoloration by stain-fungus; B, Typical light-colored, powdery frass at base of stump.

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